

of our epoch should jointly undertake a photographic survey of the heavens at the present time, taking care to determine the constants which would allow of the positions and magnitudes of stars being determined with the greatest possible precision. Eighteen observatories have provided themselves with instruments essentially of the same pattern, and most of them are now at work on this chart. Details, far more numerous than was at first anticipated, were settled at two other conferences in 1889 and 1891; or by correspondence between members of sub-committees. But it would be difficult to over-estimate the importance of Admiral Mouchez's energy and labour in this preliminary work. His activity in communicating with the sub-committees, his tact and courtesy on occasions of divergence in opinion, his keenness in perception of the wisest course, have smoothed difficulties which, if not perhaps insurmountable, have at times bid fair to delay the undertaking very seriously. With his help a start has been effected which will go far to ensure a successful issue. One of the last things M. Mouchez did as Director, was to establish (in 1892 February) a micrometrical service for measuring the photographs.

Towards the end of his life, Admiral Mouchez suffered from almost total deafness, which was a serious hindrance to some of his work; but the devotion of his friend, Miss Klumpke, did much to obviate the difficulties that might otherwise have arisen. From her many of the particulars in the present brief notice have been gathered. We learn from her that on 1892 June 24, "whether feeling the need of a well-deserved rest, or with some mysterious prevision of his approaching end, the Director convoked MM. Davanne, Loewy, Wolf, Paul and Prosper Henry, and read out the programme he had prepared on various subjects under discussion, requesting them to share with him the responsibility of their solution. Having thus made, as it were, his scientific will, having confided to their hands the great work he had begun, he returned to his beautiful country-seat at Wissous. On arriving there he declined all nourishment and laid down to rest, and before another dawn he had passed peacefully away, surrounded by his loving and devoted family." He died on 1892 June 29.

LEWIS MORRIS RUTHERFURD was born at Morrisania, N.Y., on 1816 November 25. He graduated at Williams College, where he gave evidence of considerable scientific ability and zeal. He was called to the Bar in 1837, but having married a lady of some fortune early in his career, in 1849 he abandoned the law to devote all his energies to science. He first came to Europe, and remained there for some time travelling and studying. On his return to New York he erected a small observatory (transit, clock, and equatoreal) at the back of his house, and his observations were from the first of considerable importance. In 1863 he published in *Silliman's Journal* a paper on the spectra of stars, Moon, and planets, which is the first published attempt at classi-

fication of star spectra.\* He there suggested a rough classification of the spectra into three groups: "First, those having many lines and resembling the Sun, all reddish or golden stars; secondly, white stars, like *Sirius*; the third group comprising *Spica*, *Rigel*, etc., also white stars, but showing no lines."

In the course of his observations with the spectroscope Mr. Rutherford discovered its use for making a photographic object-glass, and in 1864 he succeeded in devising and constructing an  $11\frac{1}{4}$ -inch glass (*Am. J. of Sc.*, 1865 May) of fifteen feet focal length, corrected for the photographic rays, with which many very successful photographs were taken of the Sun, Moon, and stars. In 1868 he finished a 13-inch—an ordinary achromatic, to which a third flint lens could be attached in a few minutes when it was desired to use the telescope photographically. The beautiful photographs taken with these instruments were in 1890 presented to the Columbia College Observatory, together with twenty folio volumes, of about 200 pages each, containing the measures of many of the plates. A complete catalogue of them, given by Mr. J. K. Rees (*Annals of the N.Y. Acad. of Sc.* vol. vi. 1891 June) shows 175 solar, 435 lunar, and 664 stellar plates, and 174 plates of the solar spectrum. The measures were made by Rutherford with micrometers of his own devising. In the first he used a long screw, and that the measures even with this instrument were excellent was shown by Dr. B. A. Gould in two papers read to the Nat. Acad. of Sc. in 1866 and 1870. The merest summary of these papers was published at the time, and the details were not printed till many years after. In 1870 Dr. Gould was, as is well known, called to Cordoba for (as he then thought) three years, and he left the publication of the star measures till his return. He took with him the  $11\frac{1}{4}$ -inch telescope, but the object-glass was unfortunately cracked in transit. He put together the pieces and made some photographs of the southern stars, but afterwards obtained another lens. It was fifteen years before Dr. Gould returned to the States, and could arrange for the printing of the two memoirs by the National Academy. The real investigator, Mr. Rutherford, meanwhile made no effort towards this consummation, partly

\* It should not be forgotten that Fraunhofer, using a prism before the object-glass, observed the spectra of *Capella*, *Betelgeux*, *Procyon*, and *Pollex*, in which he recognised the solar D; and also of *Castor* and *Sirius*, which were different. These results in 1823 were really the first to show that the spectra of stars differ from each other and from that of the Sun. Immediately after Kirchhoff's discovery of the true meaning of the Fraunhofer lines, Donati in Florence, Rutherford in the United States, and Huggins and Miller in England, all worked independently (and unknown to each other) at the spectra of stars and planets. Donati published a paper on stellar spectra in the *Annali del Musso Fiorentino* for 1862, but his method and results were very imperfect. When Dr. Huggins and Dr. Miller arrived at the Royal Society, on 1863 February 26, to read their first paper (dated 1863 February 17), they were surprised to find the copy of *Silliman's Journal* containing Rutherford's paper mentioned in the text.

from ill-health and partly from that dislike to the act of publication only too prevalent among eminent scientific men. But the long-screw micrometer was not satisfactory, and Rutherford was led to devise one with a glass scale, the principle of which is now too well known to need description. The measures made with the glass-scale micrometer are at last being reduced and published by the Columbia College, and Mr. H. Jacoby has shown in two memoirs (on the *Pleiades* and the  $\beta$  *Cygni* group) how excellent are photographs and measures alike. Thus the chief part of Rutherford's astronomical work is only now being made generally accessible.

During 1870 Mr. Rutherford constructed a ruling-engine, described and figured in *Appleton's Cyclopaedia*. With this beautiful apparatus he produced superb interference gratings on glass and on speculum metal. Some of the ruled plates had 17,000 lines to the inch; they were superior to all others down to the time when Professor Rowland perfected his machine.

Among his other work may be specially mentioned his photograph of the solar spectrum by using a bisulphide of carbon prism (1864); his method of adjusting a battery of prisms to minimum deviation (1865); his demonstration of the stability of a collodion film (1872); and his project for using a glass divided circle instead of one of metal (1876).

Mr. Rutherford was one of the founders of the National Academy of Sciences. He took a most important part in the International Meridian Conference at Washington in 1885. For more than twenty years he was a member of the Board of Trustees of Columbia College, and received the degree of LL.D. at the Centenary in 1887. Weak health prevented his accepting many scientific engagements in which he was invited to take a prominent position. For twenty years past he was compelled to spend his winters either in Florida or in the south of France. He contracted a severe cold on his journey south in 1891, and never fully recovered from its effects. He died peacefully, and without apparent pain, on 1892 May 30, in his seventy-sixth year.

He was elected an Associate of this Society on 1872 November 8.